

STEREO MOC Status Report
Time Period: 2018:043 - 2018:049

STEREO Ahead (STA) Status:

1. The following Ground System anomalies/events occurred during this reporting period:

- On day 043, during the DSS-26 support, no telemetry was received due to receiver being declared red. SSR pointers were repositioned during the next track to minimize data loss. This anomaly resulted in the loss of 174 minutes of commanding and real-time telemetry. All SSR data was received. See DR #G118939 for more information.
- On day 044, during the pre-calibration for the DSS-14 support, the DSN was unable to perform range calibrations. Later in the support, turbo decoder lock was lost intermittently at 045-0222z through 045-0243z. This anomaly resulted in the loss of 8 frames of SSR data. See DR #G118944 for more information.
- On day 045, during the pre-calibration for the DSS-14 support, the DSN was unable to perform range calibrations. The station delay was set to zero. Later in the support, turbo decoder lock was lost briefly at 1943z. These anomalies resulted in the loss of 1 frame of SSR data. See DR #G118951 for more information.
- On day 045, a Return-To-Service (RTS) engineering demo was conducted with DSS-43. The purpose was to validate X-band tracking performance after the completion of the depot level maintenance. The MOC received real-time telemetry and sent four commands successfully. As the tracking, telemetry, and command data from this support were non-committed, the SSR was not played back and no instrument commands were sent.
- On day 046, during the DSS-63 support, initial acquisition of telemetry was 12 minutes late at 1742z due to an antenna drive issue at the station. This anomaly resulted in the loss of 12 minutes of real-time telemetry, commanding, and tracking data and 94 frames of SSR data. See DRs #M110468 for more information.

- On day 047, during the DSS-43 support, turbo decoder lock was lost briefly at 0707z. This anomaly resulted in the loss of 11 frames of SSR data.
- On day 047, during the pre-calibration for the DSS-14 support, the DSN was unable to perform range calibrations. The station delay was set to zero. See DR #G118956 for more information.
- On day 048, during the pre-calibration for the DSS-14 support, the DSN was unable to perform range calibrations. The station delay was set to zero. See DR #G118956 for more information.
- On day 048, during the DSS-43 support, turbo decoder lock was lost intermittently at 0303z through 0305z. This anomaly resulted in the loss of 22 frames of SSR data.
- On day 048, during the DSS-55 support, turbo decoder lock was lost briefly at 1351z. This anomaly resulted in the loss of 2 frames of SSR data.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week.

- The average daily science data return for Ahead was 6.7 Gbits during this week.

STEREO Behind (STB) Status:

1. Detailed status of the recovery activities this week to restore operations is listed below.

- On day 044 during a 3 hour 4 kHz carrier recovery search pattern support with DSS-14, 302 commands were transmitted during the support for carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. All 7 points on the pattern were covered twice. Three commands must be received sequentially to power on the transmitter.
- On day 047, during a 3.5 hour 1 kHz carrier recovery support with DSS-63, 270 commands were sent for transmitter carrier recovery. No carrier was detected by either the

DSN station or the radio science receiver team. Due to the duration of the support and the increased commands for each step, only 30 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.

- On day 049, during a 4 hour 1 kHz carrier recovery support with DSS-63, 440 commands were sent for transmitter carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. Due to the duration of the support and the increased commands for each step, only 22 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.

2. The Behind loss of communication anomaly occurred on October 1, 2014 from simultaneous failures of the star tracker and the IMU. Post superior solar conjunction, recovery operations resumed on November 30, 2015. By implementing the NASA Failure Review Board recommendations, the first recovery attempt began with carrier detection by the DSN on August 21st, through September 23, 2016. At a spacecraft range of ~2 AU, the observatory was found to be rotating slowly about its principal axis of inertia for which the uncontrolled attitude allowed some solar array input and continuous uplink and downlink communications on the LGA at emergency data rates. Over the next 22 continuous days, significant obstacles to recovery were overcome with a collaborative effort of the JHU/APL engineering team, NASA GSFC, DSN, FDF, SSMO scheduling, and Mission Operations teams. This consisted of:

- Reliably commanding a rotating spacecraft with uncontrolled attitude at a distance of 2 AU
- How to power on the spacecraft that was never designed to be off without collapsing the battery voltage
- Acquiring telemetry at 35 bps from a spacecraft that is rotating with an uncontrolled attitude
- Warming a frozen propulsion subsystem with a degraded battery and limited solar array input with an uncontrolled attitude
- Configuring, loading, and verifying EA, C&DH, and G&C parameters and macros with very limited telemetry
- Conducting an autonomous momentum dump in the blind and transitioning to C&DH standby mode and successfully receiving telemetry on the HGA indicating star tracker lock and decreasing system momentum.

However, system momentum level remained above the threshold for re-establishing attitude control with the reaction wheels. Due to the uncontrolled attitude, communication degraded and the last detection of the carrier was on September 23, 2016.

Behind Observatory Status - From the last telemetry received on September 18, 2016 and the telemetry assessment review held on February 24, 2017, main bus voltage is low, 3 out of 11 battery cells are bypassed, attitude remains uncontrolled, rotating about its principal axis of maximum moment of inertia. While likely all ~42 kg of hydrazine remains and is frozen, both pressure transducers are not functioning. EA mode is enabled and autonomy is disabled. The battery charge rate is C/10. RF is configured for the +Z LGA at emergency data rates and the range of the expected best lock frequency (BLF) is known.

In July 2017, with collaboration with GSFC, the recovery plan was revised and 61 procedures were developed and tested. Significant improvements include:

- Using the -Z LGA as it provides 2 dB more than +Z LGA
- Recovering in C&DH standby mode to better protect the battery
- Minimize fault protection usage
- Close latch valves after each thrusting operation
- Refined autonomous momentum dump to re-establish 3-axis attitude control
 - o Use IMUA as it will leave solar arrays Sun pointing
 - o Power wheels on after momentum dump

After 2.5 months of daily recovery efforts that began on August 21, 2017, to date the downlink signal has not been detected by the DSN block V receivers or the RSR team. With significant support of the DSN, two different acquisition sequences are being utilized weekly to re-establish communications with STEREO Behind using a 70m track:

1. 4 kHz Sweep - consists of repeatedly sweeping a 4 kHz uplink frequency range for which the BLF was found during the first recovery attempt. Commands are sent to power on the transmitter for 30 minutes. If no carrier signal is detected, the transmitter is powered off and battery recovery commands are sent consisting power off the IEM

switched power and PDU 1553 interface bus. This acquisition sequence is used 3 times each week.

2. 4 kHz Sweep with Search Pattern - The DSN created a diamond shaped search pattern with 7 steps of 0.037 deg, dwelling 10 min & 49 sec/step. There are two diamond patterns of 4 steps to cover the area of the estimated ephemeris error. The starting point is offset 0.02 deg for 100% uplink optimization. Repeating each diamond pattern accounts for the 30 minute RTLT. This search pattern acquisition sequence is used twice weekly during 3 hour supports, sending battery recovery commands at each step during the first day and on the second day, sending carrier recovery commands at each step.